

REMARKS

The specification has been amended to make editorial changes therein.

The Official Action objects to the form of claims 4-14. The claims have been amended in response to the objections and reconsideration and withdrawal of the objections are respectfully requested.

Claims 4-14 were rejected as unpatentable over NISHIKAWA 6,873,002 in view of IIJIMA et al. 2001/0038114 A1. Reconsideration and withdrawal of the rejection are respectfully requested.

NISHIKAWA describes a process in which crown cylinders are formed from a glue layer (TiN) and Ru is deposited over the entirety of each of the cylinders. Since the deposition of the Ru causes the adjacent cylinders to be connected by Ru, it is necessary to remove the Ru from around the cylinders to remove this connection. NISHIKAWA describes that the Ru reacts with the silicon to form a silicide, which is removed. As a result, the glue layer (TiN) is exposed at gap 33 (Figure 3K) and contacts the tantalum oxide at thickened portion 34 (Figure 3L). As explained at column 1, line 62 through column 2, line 9, this contact causes current leakage problems and should be avoided. Nevertheless, NISHIKAWA accepts this contact and alleges that the thickened portion 34 at gap 33 reduces the local current leakage (column 6, lines 57-67).

The present invention does not accept this contact and seeks to avoid contact between the TiN (first conducting material in the claims) and the TaO (the second insulating film in the claims). The contact found in NISHIKAWA is avoided in the present invention because the gap is not created. However, there is a potential for contact in the present invention at the top of the crown structure (see the exposed top in Figure 5C). To avoid contact between the TiN and TaO, the steps in claim 4 include depositing (e.g., sputtering) the second conducting material on the crown structure and on the first insulating film adjacent to the crown structure, removing the second conducting material from the first insulating film, and following the removing step growing (e.g., CVD) a film of the second conducting material on the crown structure. That is, the removing step occurs between the depositing and growing steps so that the growing step will create a film that separates the TiN from the TaO.

IIJIMA et al. do not make up for this shortcoming of NISHIKAWA. IIJIMA et al. disclose sputtering Ru first, followed by growing Ru by CVD (paragraph 0200), but they do not suggest removing the Ru from the insulator adjacent to the base of the crown structure between these steps. Indeed, they could not because their crown structure is opposite that disclosed herein. As shown in Figure 46 of IIJIMA et al., there is no insulator at the base, it is at the top of the crown structure.

Accordingly, the amended claims avoid the rejection under §103.

New claim 15 has been added. The new claim is provided below with reference numbers added to facilitate an understanding thereof, but not by way of limitation.

Claim 15 includes the steps of:

forming plural cylindrical crown structures (Figure 11J) of a first conducting material (1011; 601 in Figure 6A) in a first insulating film (1003; 607) on a substrate of the device, parts of the first insulating film (1003; 607) being between bases of each of the plural cylindrical crown structures,

depositing a second conducting material (1012; 602) on interior and exterior walls and an interior bottom of each of the cylindrical crown structures and on the first insulating material (1003; 607) between the plural cylindrical crown structures, the second conducting material (e.g., Ru) being more difficult to oxidize than the first conducting material (e.g., TiN), the second conducting material being thicker at tops of the cylindrical crown structures than at the interior bottoms thereof (Figures 6A and 11M);

removing the second conducting material (1012; 602) from the first insulating material (Figures 6B and 11N) between the plural cylindrical crown structures and in a same step decreasing a thickness of the second conducting material at the tops of the cylindrical crown structures while retaining at least

part of the second conducting material at the tops, on the interior and exterior walls, and on the interior bottom of each of the cylindrical crown structures,

following the removing step, growing a film of the second conducting material (1015; 603) on the tops, interior and exterior walls and interior bottom of each of the cylindrical crown structures using the previously deposited second conducting material as a seed for the film,

applying a second insulating film (1016 in Figure 11P) on the film of the second conducting material on the tops, interior and exterior walls and interior bottom of each of the cylindrical crown structures and on the first insulating material between the plural cylindrical crown structures, and introducing oxygen into the second insulating film.

This claim is allowable because the proposed combination does not disclose these depositing, removing and growing steps (note that these steps are defined so as to be in the order set forth in the claim). Specifically, the references do not disclose that the second conducting material is thicker at tops of the cylindrical crown structures than at the interior bottoms thereof, where the step of removing the second conducting material from between the plural cylindrical crown structures is between the depositing and growing steps and includes decreasing a thickness of the second conducting material at the tops thereof while retaining at least part of the second conducting material

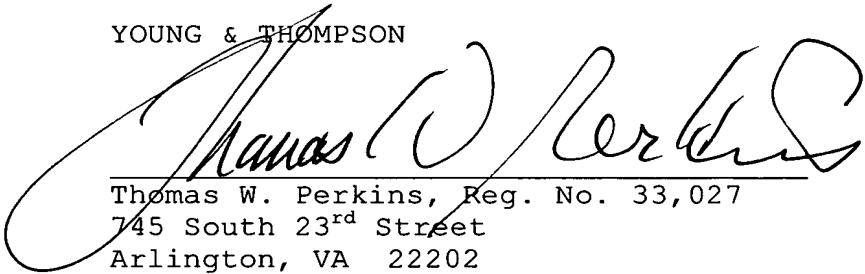
at the tops, on the interior and exterior walls, and on the interior bottom of each of the cylindrical crown structures, and where the film of second conducting material is grown on the tops, interior and exterior walls and interior bottom of each of the cylindrical crown structures using the previously deposited second conducting material as a seed for the film.

In view of the present amendment and the foregoing remarks, it is believed that the present application has been placed in condition for allowance. Reconsideration and allowance are respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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